

Sub B<sup>1</sup>  
WHAT IS CLAIMED IS:

1. A method for heat treating a semiconductor wafer, said method comprising the steps of:

5 placing a semiconductor in a thermal processing chamber, said semiconductor wafer defining at least one localized region along a radial axis;

adjusting the temperature of said semiconductor wafer to a predetermined temperature according to a predetermined heat cycle, said predetermined heat cycle including a heating stage;

10 during at least one stage of said predetermined heat cycle, controlling the localized temperature of said at least one localized region of said semiconductor wafer to minimize temperature deviation from said predetermined temperature.

2. A method as defined in claim 1, further comprising the steps of:

Sub E<sub>3</sub>  
15 monitoring the temperature of said at least one localized region with a temperature sensing device, said temperature sensing device being in communication with a controller; and

20 based on information received by said controller from said temperature sensing device, controlling the temperature of said at least one localized region according to said predetermined heat cycle.

3. A method as defined in claim 1, further comprising the step of providing a gas to at least partially control the temperature of said at least one localized region.

Sub B<sup>2</sup>  
25 4. A method as defined in claim 3, further comprising the step of controlling the temperature of said gas.

5. A method as defined in claim 3, further comprising the step of controlling the flow rate of said gas.

Sub E<sub>4</sub>  
6. A method as defined in claim 1, wherein said temperature

deviation is less than about 100°C.

7. A method as defined in claim 1, wherein said temperature deviation is less than about 25°C.

8. A method as defined in claim 1, wherein said at least one localized region comprises less than about 50% of a cross-section of said semiconductor wafer.

9. A method as defined in claim 1, wherein said at least one localized region comprises less than about 25% of a cross-section of said semiconductor wafer.

10. A method as defined in claim 1, wherein said at least one localized region comprises less than about 15% of a cross-section of said semiconductor wafer.

11. A method as defined in claim 1, wherein said localized temperature is decreased during said heating stage of said predetermined heat cycle.

12. A method as defined in claim 1, wherein said predetermined heat cycle further comprises a cooling stage.

13. A method as defined in claim 12, wherein said localized temperature is increased during said cooling stage of said predetermined heat cycle.

14. An apparatus for heat treating a semiconductor wafer comprising:

a thermal processing chamber adapted to contain at least one semiconductor wafer, said semiconductor wafer defining at least one localized region along a radial axis;

a heat source in communication with said thermal processing chamber for heating semiconductor wafers contained in said chamber; and

a device for adjusting the temperature of said at least one

Int  
Sub  
E4

5

10

Sub B3

15

Sub B4 Sub E6

20

25

localized region, said device comprising at least one gas outlet for applying a gas to said at least one localized region of said semiconductor wafer.

5 15. An apparatus as defined in claim 14, wherein said device is located below said semiconductor wafer.

16. An apparatus as defined in claim 14, wherein said gas outlet comprises a nozzle.

17. An apparatus as defined in claim 14, wherein said device comprises a plurality of gas outlets.

10 18. An apparatus as defined in claim 17, further comprising a reflective device located below said semiconductor wafer, wherein said plurality of gas outlets extend through said reflective device.

19. An apparatus as defined in claim 14, wherein said device is located above said semiconductor wafer.

15 20. An apparatus as defined in claim 14, wherein said device comprises a gas pipe having a plurality of gas outlets.

21. An apparatus as defined in claim 14, wherein said gas comprises a coolant for decreasing the temperature of said localized region.

20 22. An apparatus as defined in claim 14, wherein said at least one localized region comprises less than about 50% of a cross-section of said semiconductor wafer.

25 23. An apparatus as defined in claim 14, wherein said at least one localized region comprises less than about 25% of a cross-section of said semiconductor wafer.

24. An apparatus as defined in claim 14, wherein said at least one localized region comprises less than about 15% of a cross-section of said semiconductor wafer.

25. An apparatus as define in claim 14, further comprising:

a temperature sensing device for determining the temperature of said at least one localized region; and

a controller in communication with said temperature sensing device, said controller being adapted to adjust the temperature of said at least one localized region according to a predetermined heat cycle based on information received by said controller from said temperature sensing device.

26. An apparatus as defined in claim 14, wherein said heat source comprises a plurality of light energy sources.

27. An apparatus for heat treating a semiconductor wafer comprising:

a thermal processing chamber adapted to contain at least one semiconductor wafer, said semiconductor wafer defining at least one localized region along a radial axis, wherein said at least one localized region comprises less than about 50% of a cross-section of said semiconductor wafer;

a plurality of light energy sources in communication with said thermal processing chamber for heating semiconductor wafers contained in said chamber; and

a plurality of gas nozzles for adjusting the temperature of said at least one localized region of said semiconductor wafer, said plurality of gas nozzles being located below said semiconductor wafer.

28. An apparatus as defined in claim 27, further comprising a reflective device located below said semiconductor wafer, wherein said plurality of gas nozzles extend through said reflective device.

29. An apparatus as define in claim 27, further comprising:  
a temperature sensing device for determining the temperature of said at least one localized region; and  
a controller in communication with said temperature sensing

d vice, said controller being adapted to adjust the temperature of said at least one localized region according to a predetermined heat cycle based on information received by said controller from said temperature sensing device.

5           30. An apparatus for heat treating a semiconductor wafer comprising:

          a thermal processing chamber adapted to contain at least one semiconductor wafer, said semiconductor wafer defining at least one localized region along a radial axis, wherein said at least one localized region comprises less than about 50% of a cross-section of said semiconductor wafer;

          a plurality of light energy sources in communication with said thermal processing chamber for heating semiconductor wafers contained in said chambers; and

15           a gas pipe comprising a plurality of gas outlets for adjusting the temperature of said at least one localized region of said semiconductor wafer, said gas pipe being located above said semiconductor wafer.

          31. An apparatus as defined in claim 30, wherein said gas pipe is made from a material selected from the group consisting of sapphire and quartz.

20           32. An apparatus as defined in claim 30, further comprising a wafer rotation mechanism.

          33. An apparatus as defined in claim 30, wherein said gas outlets are positioned equidistantly.

25           34. An apparatus as defined in claim 30, wherein said gas outlets are positioned such that the number of gas outlets corresponding to an outer localized region of said wafer is greater than the number of gas outlets corresponding to a center localized region of said wafer.

          35. An apparatus as defined in claim 30, further comprising a

guard ring.

36. An apparatus as defined in claim 30, further comprising an inner gas pipe at least partially contained within said gas pipe, said inner pipe being positioned to distribute a gas to at least one outer localized region of said semiconductor wafer.

37. An apparatus as defined in claim 30, wherein said gas pipe comprises at least two lines of gas outlets.

38. An apparatus as defined in claim 30, wherein at least one of said gas outlets is positioned at an angle between about 60° to about 120° in relation to said radial axis of said semiconductor wafer.

39. An apparatus as defined in claim 30, wherein at least one of said gas outlets is positioned at an angle of about 90° in relation to said radial axis of said semiconductor wafer.

40. An apparatus as defined in claim 30, wherein said gas pipe is positioned between a space defined by at least two of said light energy sources.

41. An apparatus as define in claim 27, further comprising:  
a temperature sensing device for determining the temperature of said at least one localized region; and  
a controller in communication with said temperature sensing device, said controller being adapted to adjust the temperature of said at least one localized region according to a predetermined heat cycle based on information received by said controller from said temperature sensing device.

Added  
D<sub>1</sub> 7

Added  
E<sub>10</sub> 7

Added  
F<sub>1</sub> 7